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LEAGUE OF NATIONS

HEALTH ORGANISATION

TUBERCULOSIS STATISTICS[1]

SUMMARY OF THE REPORT

ADDRESSED BY DR. S. ROSENFELD (VIENNA)

TO THE

HEALTH COMMITTEE OF THE LEAGUE OF NATIONS

APRIL 1925.

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GENEVA 1926.

[1] " Die Tuberkulosestatistik ", von Dr. Siegfried ROSENFELD (Wien) ; Genf, den 1. April 1925 (C.H. 284. 1925).

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FOREWORD

This Summary in English contains the essential parts and the conclusions of the important report prepared for the Health Organisation of the League of Nations by Dr. Siegfried Rosenfeld (Vienna) on " Tuberculosis Statistics " (C.H. 284), and published in German (" Die Tuberculosestatistik ") on April 1st, 1925.

The object of Dr. Rosenfeld's enquiry was to ascertain the extent to which existing tuberculosis mortality statistics can be used as a basis for an international investigation of the causes of the decline of tuberculosis mortality.

Dr. Rosenfeld passes in review the tuberculosis statistics of various countries and the processes by which their data are gathered, elaborated and presented. His report gives an estimate of the errors which these processes may have produced in the statistics and thus enables the research worker to correct these errors and utilise the data for the study not only of the causes of the variation of tuberculosis mortality but even of the causes themselves of this mortality.

To indicate the methods which he thinks best to give trustworthy tuberculosis statistics suitable for research work, Dr. Rosenfeld has illustrated his reasoning by many concrete examples, drawn directly from official statistics or elaborated by himself.

It has been, unfortunately, impossible to publish these numerous statistical illustrations in this Summary, but the index will enable the reader to find them in Dr. Rosenfeld's original German text.

I. INTRODUCTION

1. In order to fight contagious diseases with success, their relative importance and the loss of human life which they cause must be known. The losses occasioned by tuberculosis have not struck the imagination of the public as the terrible epidemics of former times did, because they are more usual. These losses, however, are extremely important and make it imperative that the fight against tuberculosis be continued with the utmost energy. The following table, which contains a general review of tuberculosis mortality in the various countries of the world, gives proof of this importance.

TABLE I.

STATES, PROVINCES OR COLONIES	Causes of Death	Period of Observation	Annual Average of Deaths	Rates per 100 Deaths	Rates per 100,000 Population
A. Europe.					
Austria (pre-war)	TP[1]	1881–1890	88,460	13.03	384
		1891–1894	86,781	12.79	384
	TBC[2]	1895–1900	88,391	13.46	348
		1901–1910	88,244	13.82	322
Belgium	TBC	1888–1890	11,004	8.98	181
		1899–1900	9,619	7.80	149
		1901–1910	7,856	6.66	109
England and Wales.	TP	1881–1890	47,397	9.03	173
		1891–1900	42,622	7.59	139
		1901–1910	39,689	7.56	116
Finland.	TP	1881–1890	5,656	12.12	255
		1891–1900	6,758	13.51	266
		1901–1910	8,167	15.67	281
France	TP	1906–1910	72,094	9.55	184

[1] The abbreviation "TP" means Pulmonary Tuberculosis.
[2] The abbreviation "TBC" means Tuberculosis (all forms).

STATES, PROVINCES OR COLONIES	Causes of Death	Period of Observation	Annual Average of Deaths	Rates per 100 Deaths	Rates per 100,000 Population
Germany	TP	1892–1900	109,298	9.33	206
		1901–1910	99,252	8.76	163
Prussia	TBC	1881–1890	85,750	12.20	301
		1891–1900	72,702	10.38	226
		1901–1910	65,805	9.56	176
Hungary	TBC	1896–1900	68,540	13.16	363
		1901–1910	77,012	14.95	383
Ireland	TP	1881–1890	10,331	10.16	209
		1891–1900	9,738	11.64	213
		1901–1910	8,942	11.65	202
Italy	TBC	1887–1890	38,621	4.80	129
		1891–1900	38,902	5.25	127
		1901–1910	39,766	5.51	119
Netherlands	TBC	1887–1890	8,462	9.30	188
		1891–1900	8,591	9.60	176
		1901–1910	8,198	9.68	146
Norway	TP	1881–1890	2,754	8.30	142
		1891–1900	3,957	11.69	184
		1901–1910	4,375	13.40	190
Scotland	TP	1881–1890	7,716	10.37	199
		1891–1900	7,160	9.15	169
		1901–1910	6,348	8.30	137
Serbia	TBC	1891–1900	5,625	8.94	239
		1901–1910	8,060	12.67	296
Spain	TP	1900	23,026	4.29	124
		1901–1910	26,952	5.60	141
Switzerland	TP	1881–1890	6,132	10.14	211
		1891–1900	6,094	10.26	194
		1901–1910	6,262	10.57	177

STATES, PROVINCES OR COLONIES	Causes of Death	Period of Observation	Annual Average of Deaths	Rates per 100 Deaths	Rates per 100,000 Population
B. Asia.					
Ceylon	TP	1881–1890	1,916	2.76	67
		1891–1900	2,707	3.01	83
		1901–1910	3,769	3.41	98
Japan	TP	1886–1890	40,133	4.92	101
		1891–1900	59,803	6.71	140
		1901–1910	73,376	7.28	124
Philippines	TBC	1908–1911	16,710	10.1	302
C. America.					
Argentine :					
Province of Buenos Ayres . .	TBC	1901–1912	2,324	10.65	148
Province of Tucuman. . . .	TBC	1901–1912	242	3.17	83
British Empire :					
Antigua and Barbados . . .	TP	1907–1911	62	6.8	190
Bermudas	TBC	1907–1911	40	11.2	253
British Guiana.	TBC	1906–1911	682	7.0	232
Canada : Alberta	TBC	1905			
		1907–1909	165	7.7	64
British Columbia . . .	TBC	1902–1911	215	9.0	72
Nova Scotia.	TP	1909–1912	867	11.82	177
	TBC	1910–1913	978	13.1	199
Ontario.	TBC	1881–1890	2,531	11.14	124
		1891–1900	2,864	11.54	128
		1901–1908	2,770	9.35	125

STATES, PROVINCES OR COLONIES	Causes of Death	Period of Observation	Annual Average of Deaths	Rates per 100 Deaths	Rates per 100,000 Population
British Empire *(continued)* :					
Grenada	TBC	1901–1913	97	6.70	148
	TP	1907–1911	90	6.3	136
Honduras (British).	TBC	1907–1911	55	5.5	138
Jamaica	TP	1881–1890	1,027	7.34	170
		1891–1900	1,137	7.39	163
		1901–1910	1,270	6.62	146
Newfoundland and Labrador	TP	1901–1914	779	19.23	254
Saint Lucia	TBC	1907–1911	68	6.7	140
St. Kitts, Nevis and Anguilla	TBC	1907–1911	108	9.5	246
St. Vincent	TBC	1907–1911	55	6.9	130
Trinidad and Tobago	TBC	1907–1911	734	9.3	226
Chile.	TBC	1906–1910	9,797	9.5	297
	TP	1885–1890	5,996	6.76	232
		1891–1900	7,092	7.97	250
		1901–1910	8,298	8.23	257
Costa Rica	TBC	1901–1913	287	3.41	83
Cuba.	TP	1902–1912	3,313	10.48	165
United States of America :					
Middle Atlantic States . . .	TBC	1907–1913	45,260	10.5	165
Mountain States	TBC	1906–1913	2,069	14.17	178
North Central States. . . .	TBC	1907–1912	24,097	10.09	144
Pacific Coast States	TBC	1906–1913	5,893	13.43	167
U. S. A. (all together). . . .	TP	1900	55,910	10.35	73
		1901–1909	59,860	10.12	64

STATES, PROVINCES OR COLONIES	Causes of Death	Period of Observation	Annual Average of Deaths	Rates per 100 Deaths	Rates per 100,000 Population
Colonial Possessions of U.S.A. :					
Hawaii	TBC	1907–1911	294	11.9	187
Panama (Canal Zone)	TBC	1906–1914	301	12.16	375
Porto Rico	TP	1904–1908	1,771	7.4	169
Nicaragua	TBC	1908–1911	227	2.3	420
Uruguay	TBC	1907–1911	1,476	9.4	136
Venezuela	TBC	1905–1909	5,264	9.6	199
D. Commonwealth of Australia.					
Australia :					
New South Wales	TP	1881–1890	993	7.22	105
		1891–1900	1,045	6.76	83
		1901–1909	1,078	6.79	72
Queensland	TP	1881–1890	474	8.82	147
		1891–1900	438	7.85	93
		1901–1909	388	6.81	73
South Australia	TP	1881–1890	320	7.80	106
		1891–1900	321	7.78	94
		1901–1909	303	7.84	80
Victoria	TP	1881–1890	1,409	9.30	143
		1891–1900	1,480	9.06	125
		1901–1909	1,272	8.37	103
Western Australia	TP	1881–1890	33	5.33	91
		1891–1900	78	4.51	61
		1901–1909	178	6.34	73
New Zealand	TP	1881–1890	495	8.41	87
		1891–1900	559	8.12	79
		1901–1909	582	6.79	59
Tasmania	TP	1881–1890	96	8.41	74
		1891–1900	124	6.06	78
		1901–1909	116	5.95	65

The fact that figures are lacking for Africa does not mean that that continent is free from the disease. All the countries of the globe, from the coldest to the hottest, suffer from tuberculosis, and the fight against it is of world-wide importance. The number of people dying each year from tuberculosis in Europe alone exceeds one million.

The proportionate mortality from tuberculosis varies in the different countries of Europe from one-seventh to one-fourteenth of the total mortality. In America, where statistics are less reliable, the difference between these two extremes is still greater.

2. The proportion of deaths from pulmonary tuberculosis is decreasing in England, Scotland, Belgium, Australia, New Zealand. The decrease is also shown by the rates of mortality per 100,000 inhabitants. In comparing the average tuberculosis mortality of two recent decades (1881-1890 and 1901-1910), it will be seen that the countries enumerated in the following table show a decline.

TABLE II.

Rates of Tuberculosis Mortality per 100,000 *Inhabitants (Yearly Decennial Average).*

	1881-1890	1901-1910
Belgium	259	109
England and Wales	173	116
Holland	194	146
New South Wales	105	72
New Zealand	87	59
Prussia	301	176
Scotland	193	137
Switzerland	211	177

Other countries show stationary rates or even increases.

TABLE III.

Rates of Tuberculosis Mortality per 100,000 *Inhabitants (Yearly Decennial Average).*

	1881-1890	1901-1910
Canada	124	125
Ceylon	67	98
Chile	232	257
Finland	255	281
Japan	101	124
Norway	142	190

3. The variations from one country to another or from one year to another in the same country make us wonder whether these rates are really exact and if the data on which they are based are themselves comparable both in space and in time. Before being able to use, and draw conclusions from, comparative statistical data, we must look for, estimate and, if possible, eliminate the errors which they may show. This is true of mortality statistics ; it is still more so of morbidity statistics.

4. Tuberculosis mortality statistics show the same type of error as all mortality statistics, but they have certain errors of their own. For instance, RAHTS[1] considers that the deaths from bronchitis are so much more frequent in England than elsewhere that many of them would be ascribed to phthisis in other countries. The same might apply to various chronic pulmonary conditions of adults and to the ailments of new-born babies known as " convulsions, atrophy, congenital debility, etc.[2] ".

In spite of the fact that the layman is generally able to recognise pulmonary tuberculosis[3], it is difficult to consider as synonymous with " phthisis " the terms he uses such as " debility, weakness, chronic pulmonary diseases ". These symptoms may, indeed, be due to causes other than tuberculosis. The layman is not able to recognise cases of non-pulmonary tuberculosis.

It is not possible to say, *a priori*, in which way the lack of medical certification of the cause of death may affect statistics. ROSENFELD[4] and TELEKY[5] believe that in Austria the lack of medical certification tends to exaggerate the actual number of deaths from tuberculosis. KARLSEN[6], on the contrary, thinks that the figures of tuberculosis would be doubled if the cases where tuberculosis is a complication of infectious diseases in childhood and the cases of senile tuberculosis were included in the tuberculosis statistics.

All authors agree that the reliability of registration of non-pulmonary tuberculosis is less than that of pulmonary tuberculosis ; the figures for this form of the disease are, indeed, more reliable than those concerning all forms of tuberculosis put together.

5. There are three main types of error :

1. Those due to the official regulations governing the establishment of statistics.

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[1] RAHTS : " Die Zahl der Sterbefälle und deren Hauptursachen in einigen Deutschen und ausserdeutschen Städten, Stadtgruppen und Staaten " in *Medizinalstatistische Mitteilungen aus dem Kaiserlichen Gesundheitsamte*, IV. Band, 1897, p. 136.

[2] RAHTS : " Untersuchungen über die Haüfigkeit der Sterbefälle an Lungenschwindsucht unter der Bevölkerung des Deutschen Reiches und einiger anderen Staaten Europas " in *Arbeiten aus dem Kaiserlichen Gesundheitsamte*, XIV. Band.

[3] PRINZING : " Todesursachen in den Europäischen Staaten 1891-1900 " in *Statistische Monatschrift*, 1903.

[4] ROSENFELD : " Zur Verbreitung der Tuberkulose in Oesterreich " in *Zeitschrift für Tuberkulose und Heilstättenwesen*, II. Band, 1901.

[5] TELEKY : " Die Sterblichkeit an Tuberkulose in Oesterreich 1873 bis 1904 " in *Statistische Monatschrift*, 1906.

[6] KARLSEN in " Oversigt over Dödsaarsgerne i Kongeriket Danmarks Bybefolkning 1890-1899 ; Copenhagen 1905, p. 39. *Idem*, 1900-1909 ; Copenhagen 1914, p. 53.

2. Those due to the imperfection of medical science or practice.
3. Those due to the mode of presentation of the statistics.

These three types may co-exist.

6. Are these errors measurable ? Not with exactitude, but they are to a certain extent : for instance, the modification of the curve of mortality which appears when a factor of error disappears allows one to estimate this factor, supposing that the actual mortality remains constant.

Statistics may not be modified at once by a change in the classification. Custom may have changed before the rules have legalised this change. A change of classification may not bring immediately the expected changes in the rates, because, in reality, conditions may have altered. Such was the case in Austria when the rates of *all forms* of tuberculosis, grouped for the first time for the quinquennium 1895-1900, were lower than those of *pulmonary* tuberculosis alone in the preceding quinquennium, contrary to expectations and merely because tuberculosis was actually declining at the time.

It took several years, in England, to transfer gradually the diagnoses from one to the other of the co-existing designations : " tabes mesenterica " and " tuberculous peritonitis ".

It is therefore necessary to be familiar with the statistics of the past in order that one may understand those of the present in any given country.

In spite of the great difficulties indicated above, it seems possible to determine statistically the influence of the various causes of error and thus to make possible a comparison of tuberculosis mortality statistics both in space and time.

II. INFLUENCE OF OFFICIAL REGULATIONS GOVERNING THE ESTABLISHMENT OF TUBERCULOSIS STATISTICS.

1.

7. The regulations governing the elaboration of the statistics of tuberculosis mortality differ considerably from one country to another. These rules and regulations can be classified in accordance with the answers to the following questions :

(a) Registration of the cause of death :
Who determines the cause of death ?
In what manner is this determination made ?

(b) What are the other rules governing the determination of the causes of death in general and of tuberculosis in particular ?

(1) Methods of the Determination of the Causes of Death.

8. The causes of death may be determined by :

The attending physician (certificate after treatment) ;
The official medical inspector (medical certificate after inspection) ;
An official non-medical inspector (without medical certificate).

It is quite exceptional that the layman is able to give reliable information about the cause of death, and even a medical examination by a doctor without previous knowledge of the patient and without an autopsy has little value. Certification by the attending physician is undoubtedly the best. The value of the mortality statistics will depend upon the proportion of deaths medically certified in this fashion. The following general statements are warranted :

(i) The smaller the proportion of non-medically certified deaths, the more reliable the mortality statistics.

(ii) Statistics are more reliable in the city than in the country ; and also in the larger cities than in the smaller ones. At all ages, the proportion of deaths not medically certified is greater among the peasants than among the rest of the population [1].

(iii) Outside the differences existing between the cities and the country, industrial and agricultural regions, marked variations may be found between one province and another in the same State (Austria, Italy, Switzerland). These differences seem

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[1] " Ehe, Geburt und Tod in der Schweizerischen Bevölkerung während der zehn Jahre 1891-1900. 5. Teil, *Die Todesursachen* ; Berne, 1916.

to be due to an unequal social and intellectual development (compare, for example, white and coloured population of South Carolina) [1].

(iv) The reliability of the statistics varies but slightly with the sex of the deceased.

(v) The reliability varies greatly with the age of the deceased. Medical certification, which is frequent at adult ages, is less frequent in old age, and still less so in infancy. This should be borne in mind when estimating the reliability of infantile and senile tuberculosis statistics, and also in the comparison of mortality from pulmonary and from meningeal tuberculosis, because of the differences in age incidence.

In order that the value of statistics of general and tubercular mortality may be judged, it would be necessary that each State should publish the percentage of the medically certified deaths in its territory.

(2) Medical Certification of Tuberculosis.

9. It would also be necessary that each State give the percentage of medically certified tuberculosis deaths. Tuberculosis is more frequently medically certified than most other diseases. Most of the cases diagnosed as " tuberculosis " are really due to this affection. It is likely, however, that cases of tuberculosis, not recognised as such, are hidden under the other headings of the nomenclature when they are not certified by a physician.

Medical certification is not uniformly frequent, and it differs in a single country for the different forms of tuberculosis. The physician is not called as often to attend, and eventually certify, cases of acute miliary and cases of chronic pulmonary tuberculosis. Moreover, there are cases which the physician alone is able to diagnose (uro-genital tuberculosis, for instance). The reliability of the diagnosis in the death certificates will then vary from one form to another of the disease.

There is no marked difference in the reliability of the diagnosis in the two sexes, medical treatment being applied with the same frequency in both. On the other hand, the age of the deceased is of great importance ; during the first year of life, medical treatment is less frequently given than in the following years, and consequently the statistics concerning this first year are not as exact as the others.

The degree of civilisation and the social status have a marked influence upon the mortality rates, as shown by the statistics for the white and coloured population of South Carolina. This makes it very difficult to compare the differences in fatality of tuberculosis in two races.

These observations concerning tuberculosis are in agreement with those previously made about the causes of death in general.

It may be concluded from what has been said above that the different forms of tuberculosis should not be mixed in a statistical comparison, because the exactness

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[1] *United States Mortality Statistics*, 1921 ; Washington, 1924.

of diagnosis in the different forms is not the same. Pulmonary tuberculosis, receiving generally the most exact diagnosis, is the form which lends itself best to comparison.

(3) Estimate of the Reliability of Tuberculosis Mortality Statistics when the Proportion of Medically Certified Deaths is Unknown.

10. In the absence of official data as to the proportion of deaths certified by physicians, one may roughly estimate this proportion (where medical certification is imposed by law) by determining the facilities for reaching a physician in the country concerned. To do so, the number of physicians in proportion to the population must be known, also the density of the latter and the geographical characteristics of the country. This study touches upon the relationship between the incidence of tuberculosis and the density of the population, which is a highly controversial subject.

11. It has been thought that, tuberculosis being a " dwelling disease ", its incidence must be related to the density of the population. This relation, although frequently demonstrated, is far from being absolute, probably because of the fact that dwellings in sparsely populated districts are often little suited to the hygienic needs of the inhabitants. This relation exists in most of the States of North America, of Australia and in Japan. It is not to be found, however, in Europe, where countries like Belgium, England and the Netherlands, with very dense populations, show unusually low rates of tuberculosis mortality. In Finland, Sweden, Norway and Austria, on the other hand, the least populated districts have a comparatively higher tuberculosis incidence.

12. The pecuniary situation of the population must be taken into consideration when studying the possibility of their having a physician in attendance. The physicians attached to public medical services or to welfare organisations have not as a rule sufficient time to certify carefully the causes of death. Certificates of persons having social or private insurance policies are often falsified in the interest of the insured. The exactness of hospital mortality statistics would make it possible, by a comparison with non-hospital deaths, to judge the value of the certificates for the latter if the proportion of tuberculous patients dying in hospitals did not vary so greatly from one country to another according to hospital facilities. In Austria and Prussia, one-fourth of the tuberculous patients die in hospitals, one-ninth only in England.

2.

Consequences of the Lack of Medical Certification on Tuberculosis Mortality Statistics.

(1) *Causes of Death other than Tuberculosis.*

13. Statistics may be affected by the lack of medical certificates of the causes of death, by undefined causes of death or by erroneous diagnosis of these causes.

Ill-defined or missing certificates are either classified as such or grouped together as " Other causes of death ".

In Austria, 37.7 per cent of the deaths were classified under this heading in 1922.

Where medical certification takes place, missing or ill-defined diagnoses may still be found, but erroneous diagnoses are rare.

14. (a) *Unspecified or Ill-Defined Causes of Death.* — The lack or the vagueness o diagnoses may be studied together, since the statistics of certain countries do not make any distinction between them. Among the vague diagnoses which might possibly indicate tuberculosis we find dropsy, heart failure, consumption, cough, etc. Tuberculosis is not necessarily responsible for the same proportion of medically certified deaths as of the non-medically certified deaths. If all deaths possibly due to tuberculosis, among those improperly or insufficiently certified, be classified under the heading " Tuberculosis ", we would not modify to any great extent, in most countries at least, the tuberculosis mortality as published in the statistics. It is only in certain rural districts of Sweden, Denmark, Spain and Italy that the change would be marked.

It would appear that the diagnosis of tuberculosis is not often overlooked, as the diagnosis is generally easy.

15. (b) *Faulty Certification of the Causes of Death.* — This is the case when the layman wrongly calls tuberculosis another disease, or *vice versa.* We may estimate the number of such cases, on the one hand, by determining what are the actual causes of death corresponding to popular designations, and by determining the frequency of the diagnosis by physicians of each individual cause of death. Both methods give about the same results.

The layman might " diagnose " as kidney or heart trouble anasarca due to an amyloid degeneration of the viscera, following a long-standing tuberculous abscess. The layman will never indicate tuberculosis as a cause of death when it is a complication of an eruptive fever.

The proportion of deaths where there has been no medical attention varies with the countries. The reliability of statistics will, of course, depend upon this proportion. In the Netherlands, for eleven causes of death the percentage of cases not having had medical treatment does not surpass 1 per cent ; for convulsions and alcoholism, however, it is 5 per cent. Medical treatment is less frequent for diseases of infancy or of old age than for those in the other periods of life in Sweden, Bavaria, Saxony and Hungary.

The forms of tuberculosis for which there are no popular names are always diagnosed by a physician, and consequently death statistics concerning these contain fewer errors than the others, save omissions. These omissions are rare if medical treatment and certification of death are frequent. When medical certification of death

is not common, cases of peritoneal, bone, joint and meningeal tuberculosis are frequently overlooked.

(2) *Deaths due to Tuberculosis.*

16. Caution must be exercised in comparing tuberculosis mortality in one region with that in another, or of different periods in the same region. It will be necessary to consider specified forms of tuberculosis and not tuberculosis in general (all forms) and to examine, in the comparison of two regions : tuberculosis death rates ; the proportion of cases which a physician alone can diagnose ; the proportion of tuberculosis deaths in the age groups where medical certification is the least frequent (infancy and old age) ; the proportion of tuberculosis deaths due to the various forms.

17. (a) *Geographical Comparison.* —Switzerland and the Netherlands can be very readily used for a comparative study of tuberculosis mortality, since both countries require death certificates from the attending physician. Next come Italy and Austria, which require medical certificates of death. Then Belgium, France and Germany, where the certificates may be drawn up by laymen. England and the United States can scarcely be used for a continental European comparison.

Since medical certification has become more frequent at a time when the occurrence of tuberculosis has been decreasing, we may be quite certain that this decrease is real and not the result of a change in the methods of elaborating statistics. Indeed, tuberculosis mortality seems to have decreased more in the countries where statistics are reliable, and increased where they are not yet reliable but are improving. Tuberculosis mortality increased *pari passu* with industrialisation (Austrian cities and Japan) ; then it declined.

There is no necessary or constant relationship between medical certification and tuberculosis mortality (this is shown by the comparison of the rates in different Austrian provinces and also in Italian provinces). This relationship is, however, frequently apparent; in Styria, the infrequency of medical certification coincides with a low incidence of tuberculosis. In Italy, there is a parallelism between the frequency of medical certification and that of meningeal tuberculosis and other forms of the disease which only physicians can diagnose.

A comparison of the rates of the different cantons of Switzerland shows the same parallelism.

Neighbouring regions of countries where statistical methods are different seem, nevertheless, to have similar tuberculosis mortality rates. Such is the case in the southern provinces of Holland and in the northern part of Belgium. If there is a difference between the rates of the eastern provinces of Holland and of North-Western Germany, this is probably due to the greater industrial development of the latter region. In the case of Switzerland, we reach the same conclusions in comparing the tuberculosis rates of its cantons with the rates of the neighbouring districts of

Austria, Italy, France and Baden. The rates are higher in the countries with better statistics — that is, lower in France, equal in Baden and higher in Austria than in the neighbouring Swiss cantons. Alsace-Lorraine, which possesses an excellent statistical system, has, likewise, an apparently higher tuberculosis mortality than the neighbouring French *départements*, with the exception of Meurthe-et-Moselle.

18. (b) *Comparison of Proportionate Mortality.* — We may also to a certain extent estimate the proportion of medically certified deaths by comparing the mortality from the various forms of tuberculosis with the total tuberculosis mortality, or the tuberculosis mortality at each age-group with the tuberculosis mortality at all ages. This method is based upon the assumption that the diagnosis of tuberculosis is made for certain forms of the disease, or at certain ages of life, by the physician alone. The frequency, apparent in the statistics, of these forms which the layman cannot diagnose serves thus as an index of medical certification of the causes of death.

TABLE IV.

19. (i) *Infantile and Childhood Tuberculosis Mortality in Holland.*
(Proportional Mortality (%) of each Age-group.)

Forms of Tuberculosis	Period of Observation	Proportion of Tuberculosis Deaths			
		Under 1 year	1 to 4 years	Under 5 years	5 years and over
		%	%	%	%
Pulmonary	1901–1910	1.50	3.09	4.59	95.41
	1911–1916	1.46	2.95	4.41	95.59
	1919–1922	1.56	3.18	4.74	95.26
Generalised	1901–1910	5.08	13.46	18.54	81.46
	1911–1916	4.15	11.94	16.09	83.91
	1919–1922	6.41	15.55	22.06	77.94
Abdominal	1901–1910	13.38	12.53	25.91	74.09
	1911–1916	7.45	12.08	19.53	80.47
	1919–1922	4.28	11.05	15.33	84.67
Meningeal	1901–1910	17.83	36.27	54.10	45.90
	1911–1916	13.71	35.03	48.74	51.26
	1919–1922	14.18	34.52	48.70	51.30

The decline of abdominal tuberculosis under five years is quite marked ; on the other hand, the relative frequency of the three other forms of tuberculosis, at the various ages, has remained constant.

If in establishing such tables a comparison is made of proportionate mortality of each age for each form of tuberculosis, in different periods and in various countries, it will be seen that the changes from one period to another are insignificant.

The relative proportions have remained the same in spite of the great elevation of the rates during the war period (1914-1918) and their post-war decline (Saxony and Prussia). The post-war proportions in England have changed because the war materially reduced the child-population and consequently the absolute number of deaths of the first age-group. A comparison between the proportional rates of tuberculosis of childhood in South Carolina among the white population, where medical certification is the rule, and among the negroes, where it is more rare, shows that, in the absence of medical certification, the number of cases of tuberculosis is usually under-estimated in the earlier age-groups. We find, in fact, that the proportional rates in childhood are higher among the whites than among the negroes, whereas, in reality, tuberculosis is much more frequent among the latter. A comparison of the same proportional rates for London and for England and Wales in 1871-1880 shows that at this period, when statistics were less reliable than at present, the percentage of infantile tuberculosis deaths was lower for the kingdom than it was for London, medical certification being more frequent in that city. More recent comparisons yield much the same results. The same results are also obtained in Switzerland and in Italy (comparison of rates of Sardinia with the rest of the kingdom), in Sweden, Norway and Serbia (comparison between country and cities).

If a comparison is made, in the different countries, of the proportion of deaths of children under five years from the various forms of tuberculosis, it will be found that there is slight difference for the forms in which medical certification is frequent (meningeal tuberculosis, for instance). It may therefore be concluded that the differences in the frequency of medical certification have an influence on the relative proportion of tuberculosis deaths in childhood and at the other ages. It is difficult, however, to state, *a priori*, in which direction this influence asserts itself.

(ii) Mortality from the Various Forms of Tuberculosis.

20. Swedish statistics give us a comparison of the certain and of the probable diagnoses for the various forms of tuberculosis.

TABLE V.

	Certain Diagnosis (as investigated) Per cent	Probable Diagnosis (as reported) Per cent
Pulmonary tuberculosis	81.42	79.80
Meningeal tuberculosis	9.11	4.57
Tuberculosis of other organs	7.83	5.49
Undefined tuberculosis	1.64	10.14
	100	100

From the above table it may be concluded that one-half of the cases of meningeal tuberculosis are missed because of the lack of medical certification. In the United States, the proportion of deaths from pulmonary tuberculosis is the same for the white and coloured population. Among the latter the proportion of acute miliary tuberculosis is distinctly higher. The reason for this seems to be the fact that there is a larger proportion of children in the coloured population and probably also a racial predisposition to the disease.

If a comparison of these proportions is made in the city and in the country (Sweden), it will be found that in cities the proportion of meningeal tuberculosis is higher, and that of ill-defined tuberculosis lower, than in the country.

The diagnosis of acute miliary tuberculosis requires a long observation of the patient. It is therefore seldom made in the country. In Prussia, miliary tuberculosis appears to be four times more frequent in the cities than in the country, whereas pulmonary tuberculosis is not even twice as frequent.

Swiss statistics show a gradual decrease of the percentage of pulmonary tuberculosis as compared with tuberculosis in all forms, probably because of the increase in diagnoses of the other forms, which the physician alone makes.

In England, on the other hand, the proportion of pulmonary tuberculosis is gradually increasing, because it is being less seldom diagnosed as " bronchitis ", and abdominal tuberculosis is getting apparently less frequent than formerly because the too-comprehensive designation of " tabes mesenterica " is being abandoned.

If we analyse mortality statistics for each localisation of tuberculosis, we find that the proportional rates of the various forms remain practically constant, in the course of normal years, in those countries where statistics are reliable, when, of course, there is no alteration in the classification. The great variations of the proportional rates in Italian statistics are decreasing as the reliability of these statistics increases. This progress is shown by an increase in the rates of bone-tuberculosis, and a decline of those of abdominal tuberculosis and generalised scrofula. The proportion of tuberculosis deaths due to a *pulmonary localisation* since 1910 varies between 63 per cent. in Italy and 86 per cent. in Germany. It should be noted that, in the three countries having the best statistics (Holland, England and Switzerland), this proportion varies only between 72 per cent. and 75 per cent. Other countries differ from this average according to the imperfection of their statistics.

A greater difference exists among the various countries in the proportions of *acute miliary tuberculosis*. They range from 0.85 per cent. in Prussia to 3.19 in Holland. Such a difference cannot be explained by differences in the medical certification alone. " Acute miliary tuberculosis " may have a different meaning in these countries.

The rates of *meningeal tuberculosis* also show a great range of variation from 5.32 per cent. in Japan to 13 per cent. in Norway. Countries with good statistics show average rates of 9 to 11 per cent.

There are great differences in the proportion of *abdominal tuberculosis* from one country to another, the extreme figure of 19 per cent. for Japan being followed by 10 per cent. for Italy, 6 per cent. for England, 5 per cent. for Holland and 4 per cent.

for Switzerland. It is difficult to conceive that differences in the infection of the milk consumed in these various countries can bring about such differences in the rates.

Proportional rates of *bone-and-joint tuberculosis* can scarcely be compared from one country to another because of marked differences in classification. From 7 per cent. in Switzerland, it falls to 2 per cent. in Norway, where statistics are less reliable. In a general way, it may be said that the rates of these two forms of tuberculosis vary with the frequency of medical classification.

21. In summing up, it would appear that the lack of medical certification of the causes of death gives rise to the following errors in statistics : a decrease in the number of deaths due to bone-and-joint, miliary, and meningeal tuberculosis and tuberculosis of other organs ; a slighter diminution of the number of deaths from pulmonary tuberculosis ; finally, in certain countries, an increase in the number of deaths from abdominal tuberculosis and scrofula.

22. In the previous paragraphs we have dealt separately with the effects of the lack of medical diagnosis of the causes of death on the proportion of tuberculosis deaths in each age-group and on the relative proportion of deaths from each form of tuberculosis. We can combine both methods and consider the effect on the proportional rates of the various localisations in children under one year.

TABLE VI.

Percentage of the Various Localisations in Children under One Year.

Country	Period of Observation	Pulmonary Tuberculosis	Meningeal Tuberculosis	Abdominal Tuberculosis	Generalised Tuberculosis	Other Forms
		%	%	%	%	%
Denmark. . .	1920–1922	13.3	63.8	—	11.3	11.7
England . . .	1918–1922	12.9	44.9	28.2	11.3	2.8
France. . . .	1911–1915	33.6	51.1	—	—	15.3
Holland . . .	1911–1916 1919–1922	31.0	48.0	6.9	7.2	7.0
Japan	1904–1910	31.5	50.3	13.2	—	5.0
Norway . . .	1904–1914 1917–1920	15.6	70.2	2.2	3.3	8.8
Switzerland. .	1911–1920	24.7	52.8	6.8	5.1	7.6
United States .	1909–1920	32.2	46.2	8.4	7.8	—

Table VI shows that the proportion of pulmonary tuberculosis varies between 13 per cent. in England and 33 per cent. in France. The average is about 30 per cent.

The average for meningeal tuberculosis is about 50 per cent., the maximum for this form being 70 per cent., in Norway. The English rates make quite a contrast with the average, showing an unusually small proportion of pulmonary tuberculosis and a very high one of abdominal tuberculosis. This latter diagnosis seems to be used in England with undue frequency, and this error has an effect on the other relative rates. In London, where statistics are more reliable than in the rest of the country, proportions approach more closely those of the other countries.

23. From the preceding remarks, we may conclude that, if the comparative lack of medical certification of death has an influence on statistics, this influence is not always constant, nor is it sufficient to explain all the differences between the various countries. It does not even seem to be the main factor of these differences.

3.

Consequences of the Lack of Confidential Death Certification.

24. In the preceding pages we have assumed that the physician is always scrupulous in making out his certificates of the causes of death, but this is not always the case, and tuberculosis statistics are a proof thereof.

When notification of the cause of death is not confidential, the physician may, even outside of any unintentional mistake of diagnosis, indicate a different cause from the one he knows to be true. He may do so out of consideration for the memory of the deceased, or of his family, or in order not to hurt his own reputation by admitting an error of diagnosis. The latter cause of error must exist, especially in the countries where social insurance systems are developed ; the physician who for years has treated an insured person for a so-called " chronic bronchitis " dares not retract his first diagnosis, and the cause of death on the certificate figures as such. The system of compulsory insurance having been created (1883 in Germany ; 1888, Austria ; 1891, Hungary ; 1901, Luxemburg) before the era of reliable tuberculosis statistics (1904 in Germany), it is not possible to estimate the effect of the introduction of this system upon statistics. One cannot, even without prejudice, fail to see that the development of the system of health-insurance in Austria was accompanied by a decrease in the number of deaths ascribed to tuberculosis, and by an increase of the number of cases due to inflammatory diseases of the respiratory organs. This change is particularly evident in the industrial districts, where insurance was most common. In Prussia, the facts are identical ; after the introduction of the insurance system in 1887, and especially since 1890, the rate of tuberculosis has declined, whereas the rates of " tracheitis, bronchitis, pneumonia and pleurisy " have risen. The phenomenon was especially obvious among the males and at the adult ages from 30 to 60, that is, precisely in the class of the population benefiting by the insurance system.

At that period (about 1890) the decline, apparent in Germany and Austria, was not felt in the countries (England, Scotland, Holland, Switzerland and Italy) which had not then developed any social insurance system.

In France, in cities with more than 30,000 inhabitants, a decline in the rates of tuberculosis mortality was also felt among males between 20 and 30 years of age, but without a corresponding increase in the rates of chronic bronchitis, as in Prussia and Austria. There was no change in either Switzerland or Italy at the same period. In England, there was no increase in chronic bronchitis rates.

Experience in the above-mentioned countries shows that health-insurance systems have proved to be a cause of error in the tuberculosis statistics. It is not *necessarily* so, however. The Swiss method of death registration, by preserving complete professional secrecy, allows the physician to give exact statements to the statistical registration office It is essential, in order to obtain exact statements, and consequently exact statistics, to make medical certificates of death confidential. In Switzerland, the introduction, followed by the generalisation, in 1901, of the confidential system, has raised the number of cases called " tuberculosis " considerably and produced a marked decline in the number of so-called " chronic bronchitis " cases. Since then, the rates of both diseases have gradually declined. The same phenomenon would probably occur in any country adopting a confidential system. In England, where the medical notification of the causes of death are, so to speak, public, the rate for bronchitis is abnormally high, probably because many cases of pulmonary tuberculosis are included under the heading " bronchitis ".

It is quite vain to think that the confidential system can be dispensed with, replacing it by passing laws to penalise the authors of false statements. Physicians can always claim to have made a mistake in the diagnosis.

4.

Consequences of Enquiries made to Practitioners to ascertain the Exact Causes of Death.

25. There exist, in some States, regulations which may increase the exactness of the data contained in death certificates, outside, of course, of the medico-legal autopsies or analyses, and even of the inquest cases which take place in England when the cause of death has not been certified by an attending physician (tuberculosis was found to be the cause of death in only 2.4 per cent. of these inquest cases instead of 10 per cent. in the normally certified deaths).

In Austria, the official physician, in Switzerland and Italy, the Central Bureau of Statistics, can exact from the physician who made the certificate, additional data, or the precisions of the diagnosis when the latter is ill-defined. The same is true of England and the United States. These two countries even publish the data on this complementary information. In England, the proportion of these enquiries fell from 2 to 1 per cent. of the deaths, and nearly 90 per cent. of these enquiries are answered satisfactorily by the physicians. The number of deaths which are ascribed to tuberculosis after additional information has been obtained reaches 0.5 per cent. only of the total number of tuberculosis deaths. One of the advantages of this additional information is that it indicates under which fallacious names cases of tuberculosis

may be hidden. Rosenfeld has calculated, on the basis of this complementary information in England and America, that, to the number of cases of tuberculosis published in the statistics, a co-efficient should be added as follows :

3.2 %	of	the	published	figure	for	tuberculosis (all forms)
2.2 %	,,	,,	,,	,,	,,	pulmonary tuberculosis
7.5 %	,,	,,	,,	,,	,,	meningeal tuberculosis
5.4 %	,,	,,	,,	,,	,,	abdominal tuberculosis
4.8 %	,,	,,	,,	,,	,,	generalised tuberculosis.

This figure of 3.2 per cent. shows how important the result of this system of additional information is in the case of tuberculosis. It requires, however, a permanent, active and centralised statistical office, and the education of physicians on the necessity of exact certification of the causes of death.

5.

Consequences of the Definition of Tuberculosis and the Limitations of its Field.

26. Many affections which, in the past, were held as distinct from tuberculosis and not included under this heading have gradually become classified as such. It is essential to take into account this progressive widening of the field of tuberculosis. At first it only contained pulmonary tuberculosis. Papavoine, in 1830, annexed to it " hydrocephalus acutus ". For a long time the Viennese school distinguished " phthisis " and " tuberculosis " ; " phthisis " then included many non-tubercular affections. Definitions varied from one country to another and from one period to another. It was only after the discovery of the Koch bacillus, in 1882, that the statistics became homogeneous, and, even then, only after the physicians had become used to the idea about 1890. The rates of tuberculosis mortality in England, Switzerland and Austria were not modified by Koch's discovery. This discovery did not give an absolute limit to the field of tuberculosis. Certain affections, even now, have still an obscure relationship with tuberculosis. Such is the case, for instance, of certain forms of choroiditis, of Hodgkin's disease, which was, until 1920, coupled with leukœmia, and which is perhaps a tuberculosis of the lymphatic glands. Strange to say, lymphadenia was included under the heading of scrofula until 1880. Scrofulous diseases were, for a long time, distinguished from tuberculosis (Bajinsky made the distinction until 1913). At the present time, by scrofula we mean " lymph-gland tuberculosis ", but no longer, as formerly, tuberculosis of the bones or joints. The number of deaths ascribed to scrofula has decreased progressively, but noticeably, in countries like England, Switzerland and Italy, which have maintained this heading. This decline can be explained by the change in the medical conception of the diseases classified under this heading.

Lupus was considered as tuberculous several years only after Koch's discovery. It was formerly included among cancers under the name of " ulcus rodens " (at the present time lupus forms about one-thousandth of the deaths from tuberculosis).

Addison's disease may be considered in most cases as a tuberculosis of the adrenals (it represents 2 per 1,000 of the number of deaths from tuberculosis).

Abscesses of the psoas muscle and retro-pharyngeal abscesses are nearly always the result of tuberculosis of the vertebræ and should be classified as such.

As the previous paragraphs show, classification of the causes of death depends upon medical science and the knowledge of practitioners. No national regulations or international recommendations may standardise the statistics before the practitioner has become acquainted with the new scientific facts.

6.

Classification of the Causes of Death.

27. (1) *Classification considered from the Purely Formal Standpoint.* — In ordre to have complete statistics of tuberculosis mortality, the Central Statistical Office of each country should publish, every ten years, an exact and detailed nomenclature of the affections included under the heading " Tuberculosis ". This detailed nomenclature is necessary to the elaboration of an abridged nomenclature.

In order to facilitate international comparison of mortality statistics, an international commission met in Paris in 1900 and elaborated a detailed and an abridged nomenclature or list of causes of death. These nomenclatures, revised in 1909 and 1920, have unfortunately not been adopted yet by all countries. Some use a more detailed, others a more sketchy, nomenclature. This is very unfortunate.

There is no doubt that tuberculosis statistics included in the past many deaths which were not due to this disease (this is becoming more rare as statistics better themselves). We can give instances of this fact :

In Holland, until 1887, diabetes and pulmonary tuberculosis were coupled under the same heading. Five per cent. at least of the cases thus called " tuberculosis " were indeed diabetes cases.

Until 1887 also, Belgian statistics made no distinction between pulmonary tuberculosis and all other lung diseases (the former making up two-thirds of the total).

In Finland, the deaths from whooping-cough are not distinguished from those of pulmonary tuberculosis, the rate of the latter being thus unduly raised. This excess may be estimated by bringing into comparison the proportion of mortality from whooping-cough to pulmonary tuberculosis mortality in other countries, this proportion varying from 8 to 17 per cent.

In England, until 1881, the deaths from hydrocephalus were columned among those from tuberculous meningitis because of the similarity of their name (hydrocephalus acutus).

In Switzerland, until 1900, the heading " bone tuberculosis " included cases of " osteitis, periostitis, bone-cary, osteomyelitis, etc. ", without any distinction

being made with regard to their etiology ; in the same fashion, " tuberculosis of the joints " included " acute arthritis ".

There resulted from the abandonment of this method of classification a marked decrease in the number of deaths from " bone-and-joint tuberculosis ".

In Italy, until 1894, tuberculous and non-tuberculous diseases of the bones were also confused.

In Prussia, it was only in 1903 that rickets and scrofula were dissociated and the latter classified as tuberculosis. From this change there resulted a considerable increase of tuberculosis (36.5 per cent.) in the ages under 15, and a decrease of 80 per cent. of the deaths ascribed to " rickets ".

The use of Virchow's pathological classification of diseases according to their localisation, instead of according to their etiology, has prolonged these abuses : through its use, lupus remained classified as a disease of the skin and not as a tuberculous infection, pulmonary tuberculosis as a respiratory disease, and tuberculosis meningitis as a disease of the nervous system. The existence elsewhere in the nomenclature of a separate heading of " tuberculosis " was only adding to the confusion.

No country except England published the total number of deaths from tuberculosis as long as Virchow's system was in use.

28. (2) *Forms of Classification of Causes of Death. International List of Causes of Death.* — A nomenclature of causes of death must be modified in accordance with the progress of medical science. In order to establish a nomenclature, all causes of death must be reviewed and their mutual relationships determined.

We shall consider here, in this light, the established international nomenclature.

Certain items of this classification are homogeneous : others are compounds of several different affections ; this classification is therefore not absolutely detailed.

Certain titles in this classification, sufficiently clear for the physician, are not intelligible to the layman. All the affections grouped under one title should be listed there.

Confusion may, indeed, arise from the composition of each group of the classification without any corresponding change in the title of the group. This means a real alteration of facts and not only a different interpretation of synonyms.

Therefore changes in the composition of the classification—groups and items—ought to be very obviously indicated in the statistical publications themselves.

The titles concerning tuberculosis in the International Nomenclature of Causes of Death of 1920 are the following :

31. Tuberculosis of the respiratory system.
32. ,, ,, ,, meninges and central nervous system in general.
33. ,, ,, ,, intestines and peritoneum.
34. ,, ,, ,, vertebral column.
35. ,, ,, ,, joints.

36. Tuberculosis of the other organs (with the following subdivisions) :

(a) ,, ,, ,, skin and subcutaneous cellular tissue ;
(b) ,, ,, ,, bones (vertebral column excepted) ;
(c) ,, ,, ,, lymphatic system (mesenteric and retro-peritoneal glands excepted) ;
(d) ,, ,, ,, genito-urinary system ;
(e) ,, ,, ,, organs other than the above.

37. Disseminated tuberculosis (with the subdivisions : *(a)* acute ; *(b)* chronic).

Observations concerning the various titles of this classification.

Ad 31. — Laryngeal tuberculosis was classified apart until 1920. There is no statement about tuberculosis of the bronchial lymph-glands which might be included there or classified under title 36 *(c)*.

Ad 32. — This title should cover tuberculosis of the spinal cord, which has been omitted in the list of synonyms and might at present be classified as a tuberculosis of the other organs 36 *(e)*.

Ad 33. — Tuberculosis of the intestines and peritoneum, formerly abdominal tuberculosis.

Ad 34. — " Tuberculosis of the vertebral column " has replaced the name " Pott's disease " ; Pott's disease being, properly speaking, a tuberculosis of the cervical part of the vertebral column. " Pressure myelitis " ought to have been indicated here and not placed among the " other diseases of the spinal cord ". The retro-pharyngeal abscess and the abscess of the psoas muscle ought to be included here also, and not among the diseases of the throat and of the locomotor system respectively.

Ad 35. — "Tuberculosis of the joints." This title is not quite justified, since tuberculosis of the joints is nearly always the consequence of bone tuberculosis.

Ad 36. — It is unfortunate that the division of this title into its constituents is not compulsory :

(a) The abscesses are often due to suppuration of the lymph-glands, and ought to be also mentioned under 36 *(c)*.
(b) Ought to contain the subdivision " vertebral tuberculosis ".
(c) Contains the former so-called " scrofula " cases.
(d) Ought to include Addison's disease or tuberculosis of the adrenals.

Ad 37. — " Disseminated tuberculosis. " This title should include : " amyloïd degeneration of the viscera ", which is so often the result of long-standing tuberculous suppuration.

The changes suggested above would not modify markedly the total number of deaths from tuberculosis.

Most of the Latin countries and the United States of America use the *International List*. The nomenclatures adopted by other countries are either more or less

detailed than the international one, but they give side by side the various forms of tuberculosis (the German Reich, Italy and Switzerland are exceptions to this rule).

Viennese statistics of necropsies show that the clinicians and the statisticians on one side and the pathologists on the other may have different views on what is essentially the " cause of death " (tuberculosis is given as the cause of death more frequently by the clinicians than by the pathologists). The use of the usual nomenclature should therefore be required from the pathologists for their post-mortem diagnoses, in order to avoid unnecessary confusion.

29. (3) *Rules of the Selection of the Main Cause from Joint Causes of Death.* — Besides the *International List of Causes of Death*, a set of rules has been given through the proper method of assignment to the preferred title of causes of death ; when two causes are simultaneously reported in the death certificate, seven rules have been laid down for that case.

Unless there is an indication to the contrary from the physician, the following cause will be selected :

1. The primary disease when the other seems to be only a complication of it.
2. The epidemic disease when any of the reported causes is of an epidemic nature.
3. The more fatal disease.
4. The wound, if any is reported.
5. The less common disease.
6. The more characteristic disease.
7. The disease the evolution of which is the more rapid.

The physician alone may truly indicate the relative importance of the simultaneous affections, but, if he does not indicate this relation, the statistician needs to apply definite rules for the tabulation of the causes of death.

Let us now consider how to apply these rules in cases of tuberculosis.

Ad 1. — This rule is not satisfactory because the term " complication " lacks precision and is often erroneously used as a synonym of " late symptoms " ; ex. : cold abscesses in Pott's disease. This rule is often broken when cases of diabetes, tabes or hepatic cirrhosis are ascribed to their complication " tuberculosis ".

Ad 2. — If an epidemic disease and tuberculosis are reported simultaneously, the death is ascribed either to the former (in case of smallpox, scarlet fever and diphtheria) or to the latter (in case of measles, whooping-cough and influenza). Rule 2 is therefore not literally enforced.

Ad 3. — It will be necessary to establish precise rules of graduation of the various diseases according to their fatality.

Ad 4. — An indication of the physician is essential here.

Ad 5. — This rule has no scientific character ; fatality and rarity are not synonymous.

Ad 6 — Death should be ascribed to the disease which is most exactly defined.

Ad 7 — The evolution of tuberculosis is usually considered to take one year, with the exception of the meningeal and the acute miliary forms. If rule 7 were followed, tuberculosis would very seldom be considered as a cause of death when secondary to infectious diseases such as measles and influenza, which have a more rapid course.

In England, tuberculosis is considered as a secondary cause, while it is considered as a primary one in the United States of America. When large statistical offices like those of these two countries may consider in a different way the same rule, how can the statistics be kept comparable when interpretation lies with local officials ? Many States, in order to obviate the difficulty, require from the physician the indication of the determining cause of death.

III. INFLUENCE OF THE PHYSICIANS ON THE ELABORATION OF THE STATISTICS.

1. Erroneous Diagnoses.

30. We do not deal here with wilful errors in the reports of the cause of deaths, since they have been discussed above, but with unintentional mistakes.

These mistakes may either increase or diminish the apparent number of deaths from tuberculosis. The mistakes most frequently made are the confusion of chronic pulmonary tuberculosis and chronic bronchitis in old people ; of pulmonary tuberculosis and acute bronchitis in children ; of caseous pneumonia and broncho-pneumonia following measles in children ; of disseminated tuberculosis and typhoid fever or cerebro-spinal meningitis ; of tuberculous meningitis with epidemic meningitis ; of intestinal tuberculosis and chronic enteritis ; of tuberculous peritonitis and cirrhotic peritonitis.

The names of symptoms such as " convulsions ", " emaciation ", " atrophy ", may indicate tuberculous or non-tuberculous infections. The same is true of the term " senility ".

Diagnostic mistakes are more frequent in the country than in cities ; more in regular outside practice than in hospital practice. Cabot, comparing the clinical and post-mortem diagnoses of 3,000 American hospital cases, considers the former as unreliable : according to him, the diagnosis was correct in only 59 per cent. of the cases of pulmonary tuberculosis and 52 per cent. of those of miliary tuberculosis.

But these percentages seem to be quite under-estimated, because the majority of cases going to autopsy are precisely the doubtful cases.

Confusion of corresponding tuberculous and non-tuberculous diseases is evident in statistics and may be shown by a parallel study of their rates at various periods, following the steps of progress of medical diagnosis. Thus, in Vienna, from 1891-1900, the number of deaths from meningeal tuberculosis was doubled and the number from other forms of meningitis reduced by half ; the number of deaths from non-tuberculous meningitis for 100 from tuberculous meningitis fell from 636 to 158. In all countries (England, United States of America, Holland, Italy, Japan, Switzerland) a similar change took place. The better the statistics the larger the relative proportion of tuberculous meningitis. In France, for instance, it is larger in Paris than in the other towns, and in these larger than in the country. In Sweden also it is larger in cities than in rural districts.

Since progress of medical diagnosis and reliability of statistics are parallel phenomena, the number of deaths reported as due to tuberculous meningitis increases, whilst the number from non-tuberculous meningitis is decreasing. It is impossible to admit that the sensitiveness of human meninges to the tubercle bacillus has increased ; there must have been a replacement of the diagnosis of non-tuberculous meningitis by the one of tuberculous meningitis.

This substitution is less evident for the other forms of tuberculosis. No definite conclusion can be attained by a comparison of the rates of tuberculous and non-tuberculous peritonites (including appendicitis).

If in England and in Switzerland the incidence of tuberculous peritonitis is higher as compared with non-tuberculous peritonitis, such is not the case in Italy.

The introduction of a new nomenclature of causes of death modifies still more markedly the proportions of the diseases between themselves. For instance, better definition of the forms of tuberculosis in Berlin, in 1904, produced a marked apparent increase of this disease in this city, an increase of 50 per cent. of the cases of tuberculous meningitis in one year, a rise also of the rates of pulmonary tuberculosis, and a decline in the incidence of bronchitis, which was reduced by 50 per cent. in age-groups between 5 and 40 years. The number of deaths from chronic bronchitis corresponding to 100 deaths from pulmonary tuberculosis was gradually reduced :

From	9.1	to	6.5	from 1901 to 1915	in the	United States of America.
,,	20.6	,,	18.1	from 1901 to 1922	in	Holland.
,,	16.8	,,	10.7	from 1904 to 1919	in	Norway.
,,	24.6	,,	23.4	from 1901 to 1917	in	Italy.
,,	44.4	,,	24.3	from 1881 to 1920	in	Switzerland.
,,	8.3	,,	6.8	from 1906 to 1915	in	Paris.
,,	34.6	,,	23.2	from 1906 to 1915	in	the rest of the French territory.

The proportional rate is higher in the country than in the cities, and higher in the latter than in Paris, the proportion being in inverse relation with the reliability of the certificates of causes of death.

In England the proportion was lowered from 141:100 to 105:100 from 1891 to 1920 ; the proportion remains still higher than anywhere else. In this country the death rate from acute and chronic bronchitis is extremely high and makes a sharp contrast with the extremely low tuberculosis mortality. As a rule, in countries where the mortality from bronchitis is high, pulmonary tuberculosis shows, on the other hand, a low mortality, and *vice versa*. There must be, therefore, a transfer in the diagnosis from one group to another, an error intentional or not ; for environment, climatic or professional conditions cannot be held solely responsible for the differences, if they are at all responsible.

This was the conclusion of an enquiry made by an official Dutch commission, which studied in 1918 the Belgian and Dutch statistics of tuberculosis from this point of view.

There exists a certain balance between the number of deaths from bone tuberculosis and from other diseases of the bones ; there has been an increase of the former to the detriment of the latter in Italy since 1904 ; also in England, where the former, from 1901 to 1910, increased from 1,146 to 2,188, while in the meantime deaths from other diseases of the bones fell from 762 to 66.

The same compensatory balance is also shown by Swiss statistics since 1901.

From the preceding paragraph we may conclude that tuberculosis statistics cannot be properly interpreted without taking into account the statistics of the non-tuberculous affections, corresponding to its various forms. We must always consider at the same time the figures of mortality for the corresponding tuberculous and non-tuberculous forms of the diseases and state, for instance, a decline of the mortality from pulmonary tuberculosis only in case we find at the same time a decline in the mortality from chronic bronchitis. There is no doubt that medical diagnosis is gradually becoming more perfect, and that statistics are deriving greater precision from this fact.

2. Ill-defined Causes of Death.

31. The ignorance of the exact diagnosis may bring the embarrassed physician to use as a diagnosis simply the name of one of the symptoms of the disease. This kind of diagnosis may result not only from the embarrassment of the physician but very often from his neglect. Among these ill-defined diagnoses we find, concerning tuberculosis, the following : emaciation, debility, consumption, cachexia, rickets, anæmia, infantile convulsions, senility.

Ad 1. — These terms are frequently used by laymen to designate pulmonary tuberculosis. The main difficulty lies in the distribution of these cases among the various subdivisions of the heading " Tuberculosis ".

The diagnoses " atrophia " and " senility " are getting more and more abandoned (passing from 20,372 in 1901 to 6,734 in 1919). The same is happening with the " pædatrophia " in Holland.

Ad 2. — It is very seldom that rickets is a real cause of death. It may be only a predisposing factor of the tuberculosis. This diagnosis is used less and less as a cause of death (3,539 in 1900, 2,362 in 1914 in Italy ; 1,124 in 1890, 512 in 1920 in England).

There are irregular variations in the rates of these causes in Switzerland, probably due to the fact that cases of " scrofula " are mixed with those of " rickets ".

Ad 3. —Some cases of tuberculosis may be hidden under the name of " anæmia ", but they cannot be numerous.

Ad 4. — It is quite likely that many cases of meningeal tuberculosis are covered by the title of " infantile convulsions ". This diagnosis fortunately tends to disappear, passing from 22,222 in 1891 to 4,522 in 1919 in England, and from 20,000 in 1890 to 12,400 in 1917 in Italy, and having declined by one-half in Switzerland and in Holland. This decline is obviously due to better diagnoses.

Ad 5. — The term " senility ", which undoubtedly covers many cases of pulmonary and bone tuberculosis in old people, after being used gradually more and more in England, in Switzerland and in Italy, tends now to be abandoned in the first

two countries. This increase, in Italy, cannot be entirely explained by the extension of duration of life in that country.

Thus, with the exception of the diagnosis of " senility ", all the ill-defined causes of death which could cover cases of tuberculosis are gradually falling into disuse, probably through the betterment of diagnoses.

Among the deficient diagnoses we may still indicate : meningitis, pleurisy, pericarditis, peritonitis, etc., without further precision. The physician should be required to complete his diagnosis by adding a mention such as " tuberculous " or " non-tuberculous ".

3. Physicians and Statistical Regulations.

32. After having established an exact diagnosis of the causes of death, the physician may still make mistakes in the designation of these causes through ignorance or lack of comprehension of the administrative regulations concerning the use of titles of the nomenclature. Physicians, therefore, should be trained, in view of their functions and responsibilities, towards statistics.

It is sometimes very difficult to ascribe to a specific disease a death which is a consequence of the deterioration of several organs by past affections. The works of Lubarsch, Bartel, Beitzke, Burckhardt and Naegeli in the past, and those more recent of Hirschowitz, have shown in which cases tuberculosis should be considered as the main, and in which others it should be considered as a contributory, cause of death. Tuberculosis is nearly always the main cause of death when it is indicated as the secondary cause.

Swiss statistics mention all cases, in which tuberculosis is indicated as a cause, whether primary or secondary. In 1.65 per cent. of the total number of deaths, tuberculosis seems of great enough importance to be indicated as a contributory cause. We may therefore well conceive how embarrassed the physician will be when he is allowed to indicate only one cause of death. To do away with these embarrassments, it has been found necessary to distinguish among the simultaneous causes of death the direct and indirect, the primary and secondary, the initial and consecutive, the main and the simultaneous causes of death.

The central statistical offices may in some measure rectify these errors of the classification of death certificates.

The International List of Causes of Death indicates tuberculosis as a complication to only three diseases : diabetes mellitus, tabes and hepatic cirrhosis. In reality, tuberculosis is a frequent complication of childhood infections like measles and whooping-cough, and also very frequently a complication of mental diseases.

In Prussia, for instance, tuberculosis kills in the asylums one-third of the imbeciles and 16 per cent. of the total number of the inmates. In England, if the initial mental disturbance were indicated as a cause of death of the people dying from tuberculosis in the asylums, this change of certification would reduce by 6 per cent. the tuberculosis death rate in the country, this reduction bearing mostly on acute phthisis and miliary tuberculosis.

In the United States (United States Mortality Statistics 1918) 140,144 deaths were ascribed in 1917 to tuberculosis as the principal cause of death and 16,341 (11.5 per cent. of the last figure) are ascribed to other diseases, but having tuberculosis as a contributory cause.

There are cases where tuberculosis, indicated as a mere clinical complication, is tabulated on the statistics as the main affection.

It must be noted that, in trying to determine tuberculosis morbidity, we run the risk of diminishing arbitrarily the morbidity of other diseases like diabetes mellitus, for instance, because of the frequent simultaneous presence of both these affections.

The statistician must not classify blindly, according to set rules, the various causes of death given simultaneously in the certificates. In the combination of diabetes and tuberculosis, the one and the other of those two diseases may be the main cause, or the associated or contributory cause. The tabulation must vary therefore with individual cases. If, in the United States of America, all deaths for which tuberculosis is reported as a contributory cause were classified as tuberculosis, this would increase the general tuberculosis death rate by 1 per cent. only ; on the other hand, this rate would be reduced by more than one-seventh (15 per cent.) if deaths having a non-tuberculous contributory cause were eliminated from the number of tuberculosis deaths.

In England, the same affections are tabulated on different principles, and tuberculosis is given as a secondary cause with the infectious diseases like measles, whooping-cough, diphtheria, influenza. In English the words " primary " and " secondary " indicate the relative importance of the diseases, whilst in German " primäre " and " sekündäre " indicate only the mode of succession. This difference shows the need of an agreement and the necessity of establishing a rule for the selection and tabulation as a cause of death, either the essential or the initial disease. After an agreement has been reached, physicians should be informed of the decision, and their individual judgment would prevent further errors in the future.

The Swedish, Italian, Dutch, Japanese and English statistics show a distinct co-variation between the number of deaths from whooping-cough and measles and from pulmonary and meningeal tuberculosis under five years (in England, this parallelism exists only with tuberculosis of the first year of life). This parallelism shows the narrow relationship between measles and whooping-cough, on the one hand, and tuberculosis on the other. It explains partly the decline of infantile tuberculosis by a better protection of the infants against infectious diseases. The relationship between tuberculosis and influenza is of the same kind. With the influenza epidemics in 1889-90, 1900, 1917-18, the rates of pulmonary tuberculosis have increased markedly. They fell back to their normal level after the epidemics. The parallelism between the rates of these infectious diseases and of tuberculosis clearly indicates that cases of associated infections are classified indifferently, or nearly so, either as tuberculosis or as infectious diseases.

IV. ELABORATION AND PRESENTATION OF STATISTICS.

1. Medical Bases of Statistics.

33. The only reason for the elaboration of statistics is to further medical science and also the practice of medicine, in showing the result of hygienic measures and in giving to the theory of medicine a mass of observations in which the contingencies of individual cases are lost, and in opening new fields of study.

Certain clinical localisations of tuberculosis cannot be considered as real causes of death. Such are : the tuberculosis of the eyes, of the ears, of the nose, of the mouth, of the bladder, of the skin (except lupus), because they are always secondary to another localisation and because they do not involve any organ essential to life. Other localisations may occasion death only through a long-standing suppuration bringing about amyloïd degeneration of the viscera.

We know now that tuberculosis is hardly acquired otherwise than through the alimentary tract (in childhood especially) or through aspiration into the lung. In most cases, and with the exception of primary intestinal and alimentary tuberculosis, a pulmonary affection (bronchial lymph-glands) is the origin of other localisations. We might therefore be justified in considering, for all tuberculous deaths, pulmonary tuberculosis as the primary cause.

Meningeal and acute miliary tuberculosis present very close relationships from the clinical standpoint. In practice, distinction of the localisation as the cause of death is of little importance, if these various localisations follow the same course and originate from the same source of infection. Likewise, there is no need to distinguish joint or vertebral tuberculosis from bone tuberculosis, of which these constitute forms. It is vain to distinguish intestinal tuberculosis from peritoneal or mesenteric tuberculosis. Statistics might limit the forms of tuberculosis to the following :

1. Acute miliary tuberculosis.
2. Meningeal tuberculosis.
3. Tuberculosis of several organs.
4. Tuberculosis of the respiratory organs.
5. Abdominal tuberculosis.
6. Tuberculosis of the lymph-glands (scrofula).
7. Bone-and-joint tuberculosis.
8. Lupus.
9. Bladder and genito-urinary tuberculosis.
10. Tuberculosis of other organs.

The infection takes place in the beginning of life, and the proportion of infected individuals increases with age. One generally admits that the primary infection which causes the high tuberculous infantile mortality, brings about — if it does not prove fatal — immunity against re-infection.

34. *Specific Rates of Tuberculosis Mortality.* — Tuberculosis mortality varies with the factors of development in the body of Koch's bacillus. It varies therefore *according to sex* unless the individuals of both sexes partake exactly the same life (industrial, agricultural life). The localisation of tuberculosis is not identical in both sexes. Females, for instance, present more frequently than males abdominal and cutaneous localisations (lupus) and more seldom the pulmonary forms (in Holland, England, United States of America). In Italy the female rates for all forms are higher than the male, except those for the meningeal and the bone localisations. It is therefore necessary to distinguish rates by sexes, not only for the sum of all tuberculosis but also for each individual localisation. The statistical data, thus detailed, will make possible medical researches on all the states of local minor resistance, causing the localisations of tuberculosis.

The same remark applies to the *age distribution* of the disease. The rates differ for each age-group in each sex. In Switzerland (1891-1900), the female rate exceeds the male until the age of 30, then remains lower at the ages above for all but the abdominal form. The meningeal and abdominal tuberculoses show, until age 5, a very high rate, which rapidly declines afterwards. The maximal rate for pulmonary tuberculosis is to be found in the age-group 20-29. The American statistics show a male rate lower than the female until 19, then higher from 20-39 ; then an approximation of both rates thereafter. We give here, as an example, the Swiss death-rates, specific for age, sex and the various localisations of tuberculosis.

TABLE VII.

Tuberculosis Mortality in Switzerland according to Age and Sex and the Localisation of the Disease.

(Distribution by age-groups of 100 deaths from each localisation.)

Tuberculosis	Sex	Under 5 years	5 to 19 years	20 to 29 years	30 to 49 years	50 years and above
Pulmonary . . .	M	0.42	0.43	2.37	2.21	0.79
	F	0.46	0.90	1.18	1.77	0.60
Meningeal. . . .	M	11.96	1.39	0.77	0.45	0.09
	F	13.17	1.58	0.71	0.32	0.08
Acute miliary . .	M	1.99	0.90	2.68	1.85	0.42
	F	2.12	1.66	3.23	1.25	0.24
Abdominal . . .	M	3.47	0.98	1.65	1.35	0.81
	F	2.26	1.01	2.18	1.48	0.74
Vertebral. . . .	M	2.36	1.69	2.00	1.29	0.63
	F	2.87	1.63	1.48	1.20	0.75
Joint.	M	1.95	1.61	1.83	1.17	0.81
	F	2.68	1.75	1.44	1.11	0.77

If we examine the age and sex-distributions of the deaths from each tuberculous form in all countries (United States of America, Switzerland, Japan, Norway, Holland, England and Ireland) at various times, we see that these distributions show a great resemblance between themselves. This indicates that the cause determining the localisation acts in the same way in the various countries. From the statistics we gather that the ages of maximum incidence are not the same for the various forms of tuberculosis and that for each form the age-distribution varies according to sex, but this distribution by age, sex and form of the disease is nearly identical in all countries.

What age-groupings have to be adopted for the tuberculosis mortality statistics ? The tuberculosis mortality being at low ages very high, it is necessary to give a very detailed age-distribution of the deaths of infancy and childhood. Switzerland uses the following age-groups : 0 +, 1, 2-4, 4-14, 15-19, 20-29, 30-39, etc., by ten-year groups.

Bavaria gives annual figures until the age of 15 ; Austria until age 6 ; the latter country subdivides the first year into : 0 +, 1, 2, 3-5, 6-8, 9-11 months. England does the same thing and uses the following groups : 0 +, 1, 2, 3-5, 6-11 months, then annual figures until five years. It is desirable not to give only ten-year age-groups after age 5. Five-year groups should be used until age 40, at least.

The rates of mortality must be as specific as possible. Global rates uniting, for instance, both sexes or different forms of the disease, or the different ages, may give an erroneous idea of the actual state of tuberculosis mortality, because in that way there may be merged arbitrarily rates which may be quite different in both sexes, at each age and in each form of tuberculosis.

We have seen that :

1. Global rates of deaths from tuberculosis vary according to age ;
2. Rates specific for age vary according to the form of tuberculosis considered ;
3. Rates specific for age and form vary according to sex.
4. Lastly, these rates specific for age, sex and form vary from one region to another in the same country.

In order to obtain uniformity of the statistics, it would be desirable to adopt the same nomenclature and the same conceptions of the forms of tuberculosis (for instance, the nomenclature given on page 36), and the same age-grouping — for instance, the following :

0 +	month	4	years		30–34	years	
1	,,	5	,,	(end of pre-	35–39	,,	
2–5	months			school age)	40–44	,,	
6–11	,,	6–9	,,		45–49	,,	
12–17	,,	10–14	,,		50–54	,,	
18–23	,,	15–19	,,		55-59	,,	
2	years	20–24	,,		60–69	,,	
3	,,	25–29	,,		70	,,	and above

If it is not possible to make a division as fine as the one given above, the age-grouping must not, however, be given too summarily. This is the case with the groupings adopted in France and Germany, which do not allow a detailed study of tuberculosis at the age of industrial employment. French statistics, which do not make any sex-distinction, are still more deficient from this standpoint.l

The age-grouping proposed above is quite acceptable if one estabishes two distinct kinds of statistics : general and special statistics. The general statistics could give, every year, the total of deaths caused by each disease. Special statistics might be published, for instance, every five years and could give the subdivisions by age-groups, sex and geographical distribution of certain diseases of special interest, such as tuberculosis, cancer, infantile mortality, etc. These special statistics would give enough details to allow medical and statistical researches.

2. Nomenclature of the Forms of Tuberculosis.

35. The following principles might be followed for the methodical distinction of the various forms of tuberculosis and their detailed classification.

A detailed nomenclature ought to indicate separately all the forms. The International Nomenclature, which groups under the same heading several forms, does not do it (German nomenclature is more detailed than the *International List).* Other countries also give in their statistics more details on certain points. Between these and the abridged International Nomenclature all degrees of nicety in the classification may be found.

One may :

1. Group under a single title, but separately according to sex, the exceptional forms ;

2. Not mention the localisations which are certainly secondary (bladder) ;

3. Not group any forms except those having the same origin and presenting the same evolution :

(a) One must distinguish, consequently, the general involvement of the meninges in the course of the tuberculous bacillemia from an isolated tubercle in the meninges. Though the origin and the clinical course of both cases are quite different, they are at present, nevertheless, united under the same title of " meningeal tuberculosis ".

(b) Certain forms are mostly only extensions from other localisations, for instance, pleural tuberculosis from pulmonary tuberculosis, joint from bone tuberculosis, peritoneal from intestinal tuberculosis, etc. In all these cases the physician uses either one of the associated forms for his diagnosis.

(c) The classification must enable one to make the distinction between the various environmental influences at the various ages in each sex.

(d) The classification must distinguish the forms which are more frequent in males (bone, joint, genito-urinary tuberculosis) from those which are more frequent in females (lupus, peritonitis) and from the forms which have the same incidence in both sexes. These various forms must not be mixed under the heading "other forms of tuberculosis".

(e) The various forms of tuberculosis may be divided into three groups according to their age-distribution :

(i) Meningeal and miliary tuberculosis, which are very common in infancy but decline with age.

(ii) Pulmonary tuberculosis, which is most frequent at the adult ages.

(iii) Bone, joint and genito-urinary tuberculosis, the incidents of which show little variation with age.

If we superpose these various divisions, we reach the classification which fits the nomenclature given above (page 36).

3. Presentation of Statistics.

36. The published statistics must give, together with the number of deaths at each age-group, the corresponding population figures. There is very little use for the number of deaths by age-groups or sex without the corresponding population distribution, because it is not possible then to obtain specific rates.

Specific rates are essential for international comparisons. Specificity must be obtained for age, sex and race. American statistics give many proofs of the importance of this latter factor on tuberculosis mortality ; the proportion in which each race is represented must be known, the difference of rates between individuals of each race (white and coloured), of each origin (American-born, immigrants from various countries) being considerable. In the north-east of the United States of America, the immigrants of European origin have higher death rates from pulmonary tuberculosis than the American-born, but lower rates from the other forms. Individuals of Italian stock, for instance, which have the lowest death rate from pulmonary tuberculosis, have an extremely high rate from meningeal and abdominal tuberculosis. These differences of rates can partly be explained by the differences in age distribution of the population. This shows that the rates must be specific for both race and age.

In order to make comparisons easy, in space and time, of tuberculosis death rates, one may use standardised death rates. In order to obtain these rates, one applies to the various groups of the standard population the corresponding specific rates found in the real population and obtains thus a fictitious number of deaths which the standard population would have shown if it had been submitted to the actual mortality conditions. The main advantage of the standardised death rates is that it does away with the differences in age and sex-distributions of the population of the various countries

compared. It is obvious that an international agreement must determine which population shall be used as a standard for the calculation of standardised rates.

CONCLUSIONS.

37. The tuberculosis mortality statistics are still far from being exact ; however, they tend to become so and have already made great progress in the past. Their imperfections do not prevent us from following the variations of the tuberculosis mortality if we take the necessary precautions indicated in this report. The tuberculosis statistics, analysed with enlightened criticism, may show the variations of tuberculosis mortality from all forms in the various countries for each age and both sexes. Statistics prepared in this manner may give a solid basis for researches tending to the discovery, not only of the causes of variation of tuberculosis mortality, but of the causes themselves of this mortality.

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